A Demand Response (DR) Event:

Benefits, Strategies, Automation and Future of DR

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DRRC Demand Response Research Center

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Agenda

9 am	Introductions
9:15 – 10 am	Overview of Automated Demand Response
10 – 12 pm	DR Technologies, Strategies and Case Studies
12 – 1pm	Break
1 – 2 pm	Overview of PG&E's DR programs
2 - 3 pm	DR Tools
3 - 4 pm	Future of DR

Overview of Automated Demand Response

March 3, 2011

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Demand Response Research Center

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Demand Response Research Center

Funded primarily by California Energy Commission, collaboration with Canada, NYSERDA, BPA, Seattle City Light, DOE, NIST, PG&E, SCE, SDG&E, SMUD and others

- **Communications - Developed OpenADR and launched OpenADR Alliance, >150 MW**
- **Buildings - Automation, Control Strategies, Field R&D, new work in ancillary services**

Demand Response (DR)

Federal Energy Regulatory Commission defines demand response as:

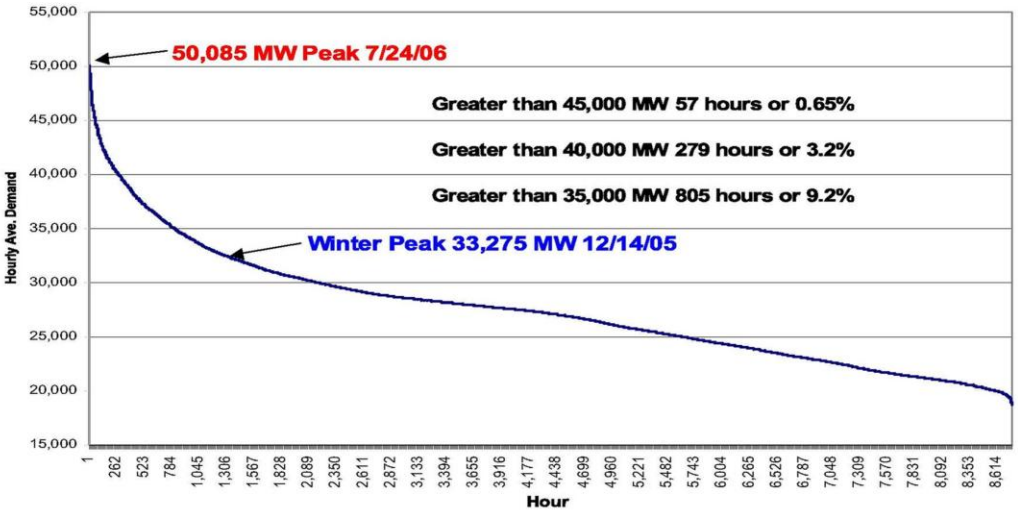
"Changes in electric use by end-use customers from normal consumption in response to changes in price of electricity over time, or incentive payments to induce lower use at times of high wholesale market prices or when system reliability is jeopardized."

California ISO
Your Link to Power

California Independent
System Operator Corporation

CAISO Load Duration Curve

Sept '05 to Sept '06



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What is Automated DR and OpenADR ?

Auto-DR is a technology infrastructure developed to meet State demand response policy goals from 2002:

- **Cost** - low-cost, automation infrastructure to improve DR in California
- **Technology** - Evaluate "readiness" of buildings to receive signals
- **Capability** - Evaluate capability of control strategies for buildings

OpenADR is an information exchange model to facilitate communication of price and reliability signals.

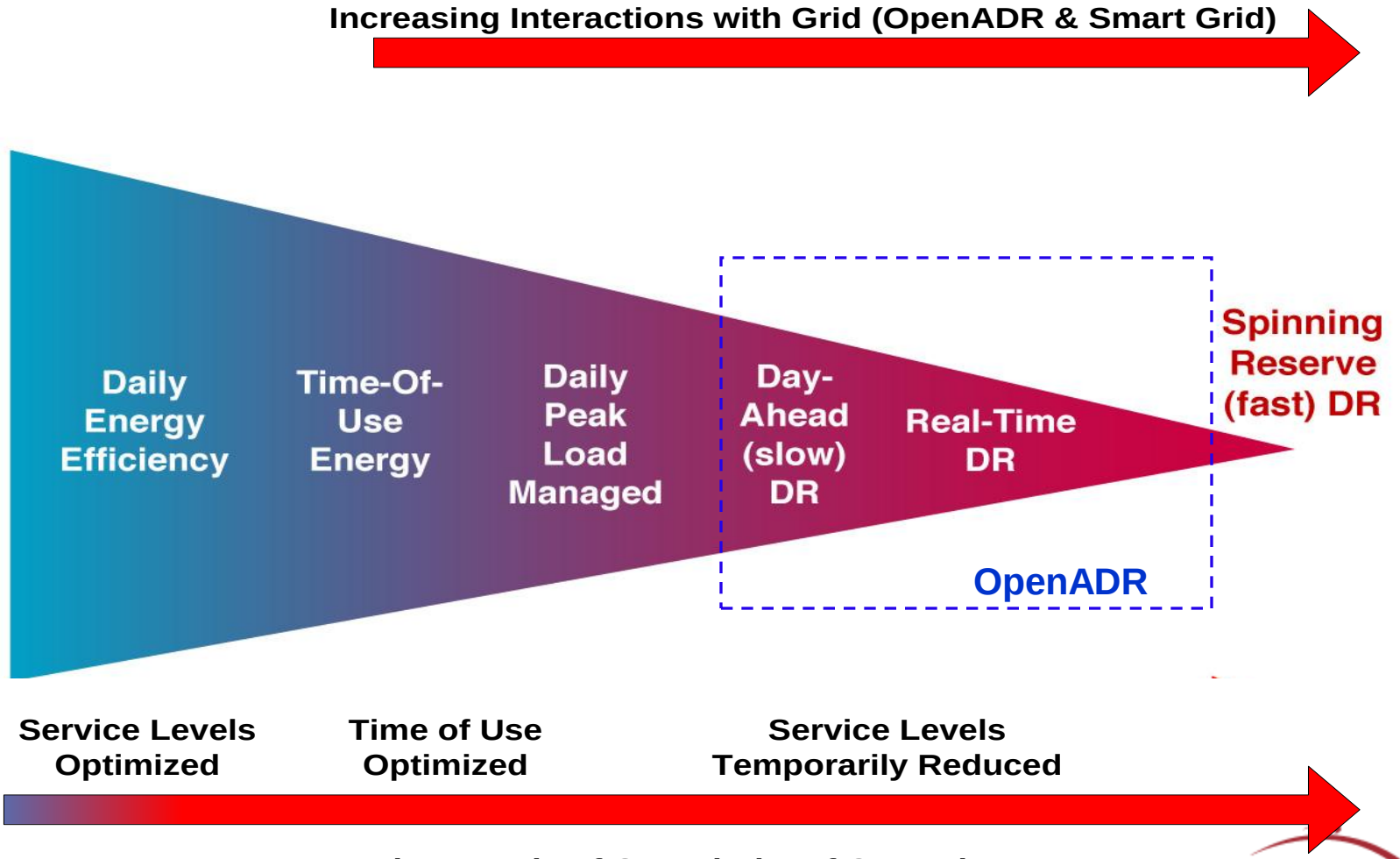
Auto-DR programs offered by utilities or ISOs automate DR using OpenADR.

"Buildings" Side of Demand Side Management

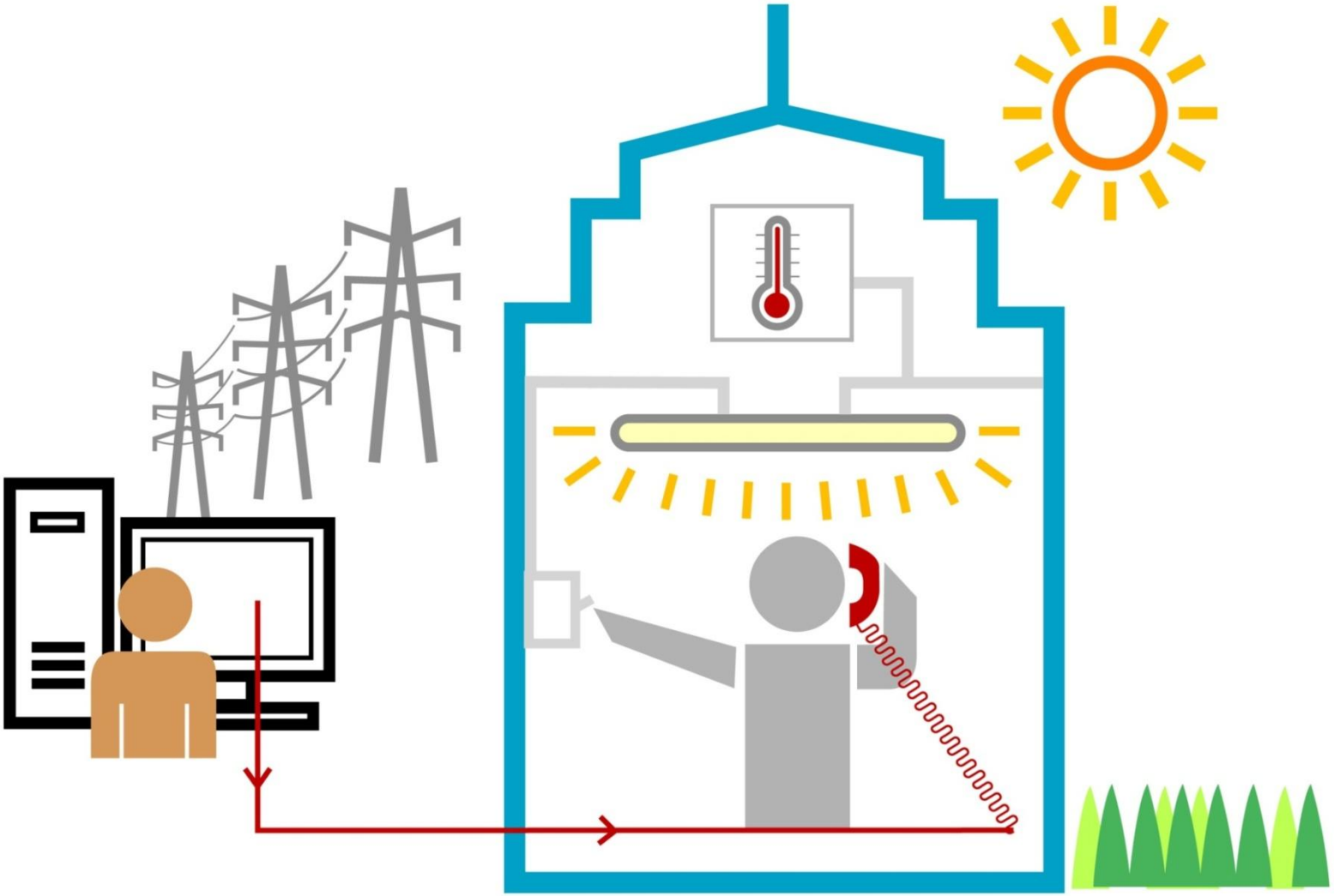
	Efficiency and Conservation (Daily)	***Peak Load Management (Daily)***	***Demand Response (Dynamic Event Driven)***
Motivation	- Environmental Protection - Utility Bill Savings	- TOU Savings - Peak Demand Charge savings - Grid Protection	**- Economic** **- Reliability** **- Emergency** **- Grid Protection**
Design	- Efficient Shell, Equipment & Systems	Low Power Design	**Dynamic Control Capability***
Operations	- Integrated System Operations	Demand - Limiting and Shifting	**Demand - Limiting, Shifting, or Shedding**
Initiation	Local	Local	**Remote**

*Prefer closed loop strategies, granular control

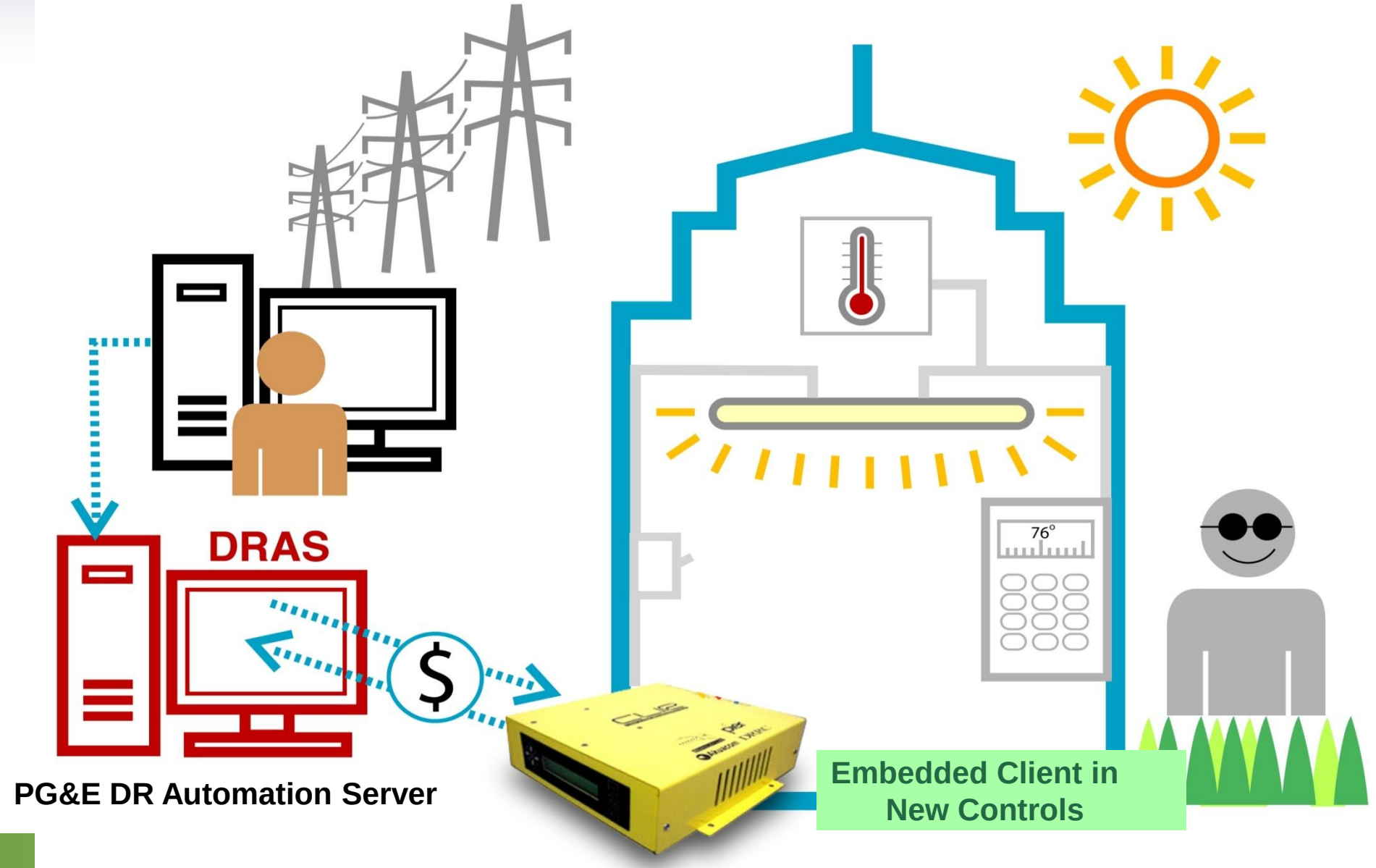
Demand Side Management and Automated DR Future



Manual Demand Response - Common Practice



Reliable, Persistent Automation with Open Automated DR Communications (OpenADR)

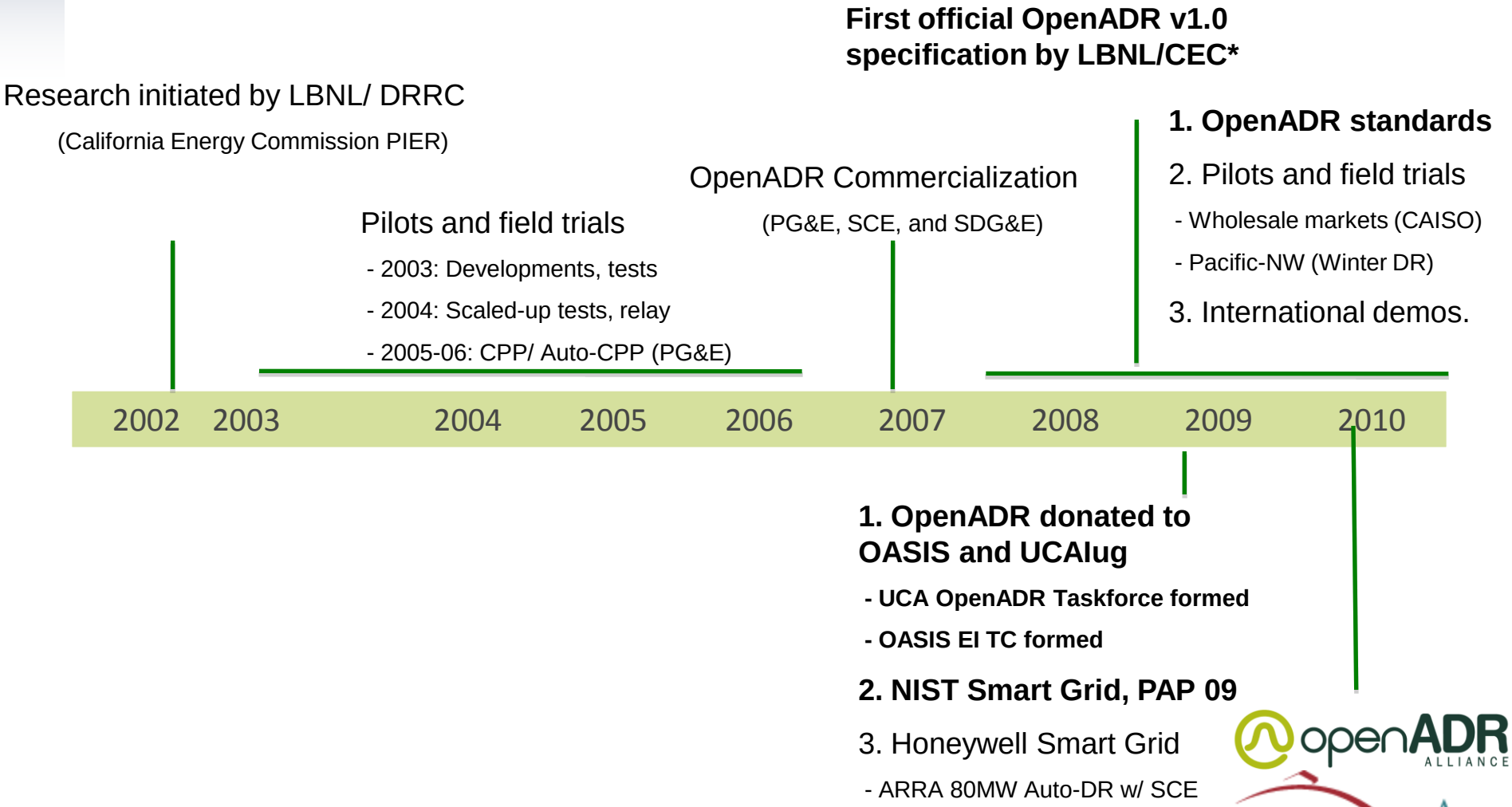


Auto-DR Multi-Year Technology Development Summary

- ❑ Develop Demand Response Automation Server (annually updated)
- ❑ Develop connection to Energy Management Control Systems (EMCS)
- ❑ Field Tests – Recruit sites/ 2 to 12 events per summer
  - 2003 - 5 sites – Internet link to Energy Information Systems (EIS)
  - 2004 - 18 sites - linked to EIS and EMCS
  - 2005 - PG&E CPP collaboration
  - 2006 - PG&E, SDG&E, Planning with SCE
  - 2007 - PG&E and SCE
  - 2008 - PG&E and SCE
  - 2009 - Bonneville Power Administration/ Seattle City Light, Participating Load Pilot w/ PG&E
- ❑ Evaluate with weather normalized baseline
- ❑ Interview site after each event

Year	# of Sites	DRAS	Site Communications	Utility
2003	5	Infotility	XML Gateway Software	None
2004	18	Infotility	XML - Internet Relay	None
2005	11	Akuacom	XML - Internet Relay	PG&E
2006	25	Akuacom	XML - CLIR	PG&E, SDG&E
2007-08	200+	Akuacom	XML - CLIR	Statewide

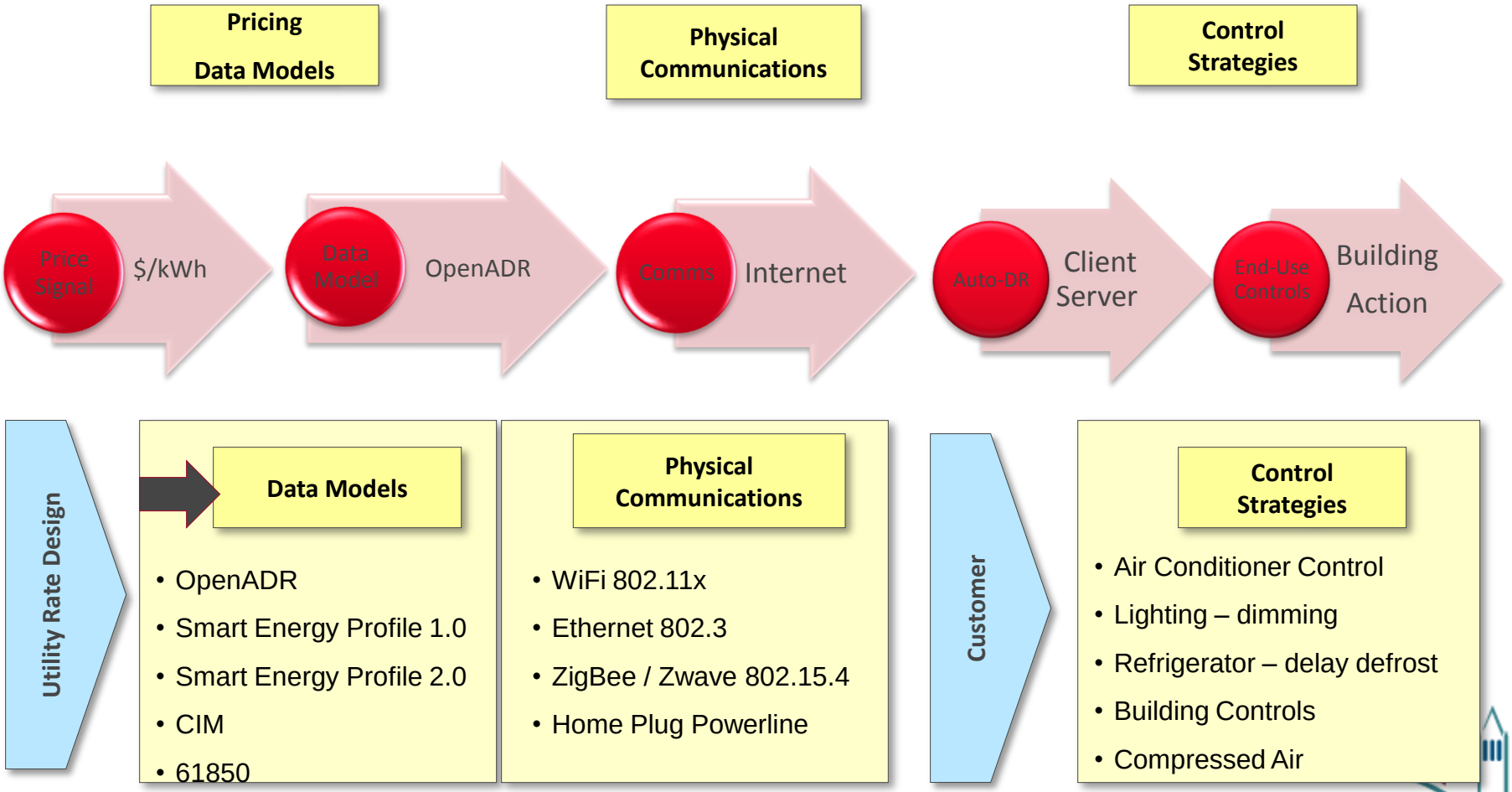
OpenADR History and Milestones



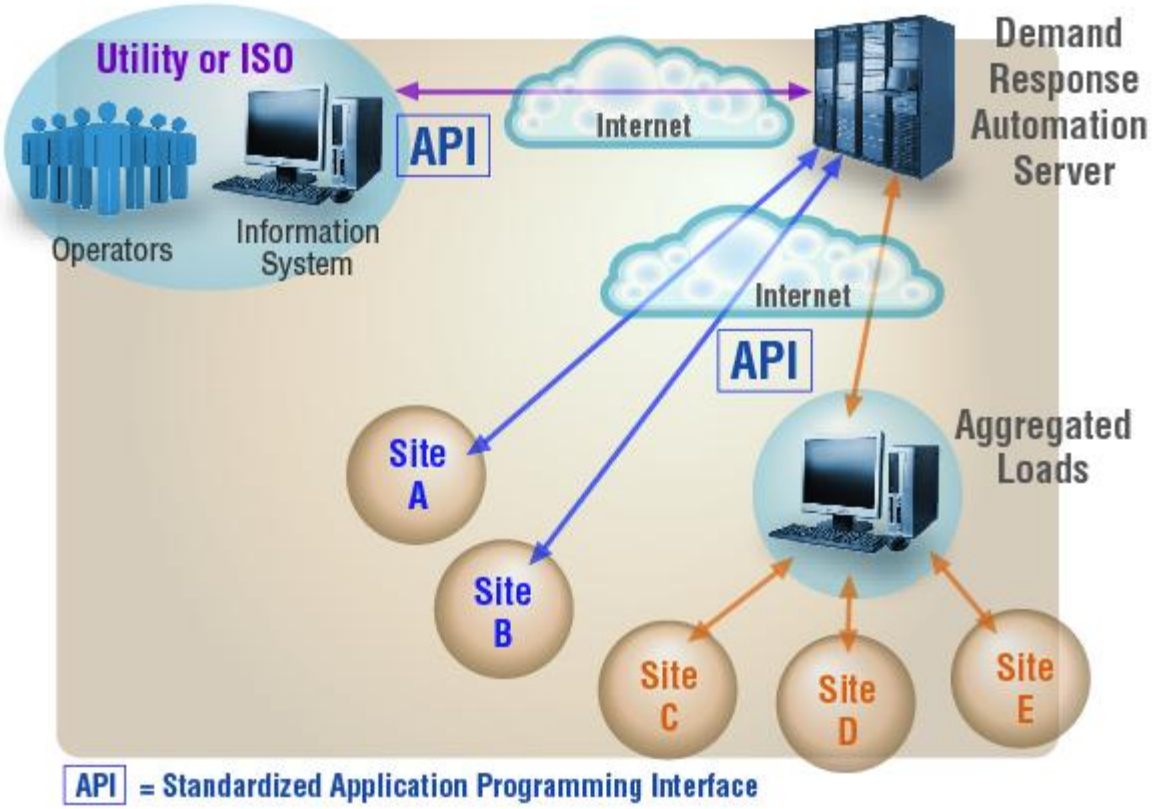
*OpenADR v1.0: http://openadr.lbl.gov/

OpenADR Information Model

OpenADR included among the original NIST 16 Smart Grid Standards.



What is Automated Demand Response (AutoDR)?



Signaling- continuous, 2-way, secure messaging system for dynamic prices, emergency and reliability signals. One-way applications are under development

Client-server architecture - uses open interfaces to allow interoperability with publish and subscribe systems

Current system - uses internet available at most large facilities or broadcasting points.

Hardware retrofit or embedded software - many clients fully implemented with existing XML software

Open Automated DR Communications Standards

Features

- **Continuous and Reliable** - Provides continuous, secure, and reliable 2 communications infrastructure.
- **Translation** - Translates DR events into continuous internet signals
- **Automation** - Receipt of signal designed to initiate automation
- **Opt-Out** - Provides opt-out or override function
- **Complete Data Model** – Describes model and architecture to communicate price, reliability, and other DR activation signals.
- **Scalable** – Provides scalable architecture scalable

Benefits

- **No stranded technology assets -** Interoperable
- **Supports RTP** - Supports states policies to promote price response.

DRRC – OpenADR Lessons Learned

OpenADR Automation

- ☑ Allows DR to be a dispatchable resource **(wholesale and retail DR).**
- ☑ Improves DR reliability, predictability, and value **(summer / winter).**
- ☑ Increases customer participation and reduces response cost **(transparent retail to wholesale DR conversion).**

Open Data Models

- ☑ Simplifies and reduces customer cost of DR **(embedded clients).**
- ☑ Creates interoperability among customer systems.
- ☑ Create interoperability between wholesale and retail systems.

Price and Reliability Signals

- ☑ Allows customers to choose level of response and how to enable DR strategies **(increases DR response).**
- ☑ Provides ability to embed automation in customer control systems **(increases DR reliability, customer participation).**

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OpenADR - Status

- Concepts developed in response to California Energy Crisis in 2001.
- Objectives: develop low cost, ubiquitous, automated demand response.
- Research began in 2002, first demo in 2003.
- 1st use at PG&E in 2005 with SCE, and SDG&E since 2006.
- Pilots and evaluations at SMUD, Seattle City Light, CAISO, plans for Florida, India, Korea and Australia.
- Formal specification published in April 2009.
- NIST nominated national standard May 2009.

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OpenADR – Status II

- **OASIS* Energy Interoperability - Technical Committee review draft published On November 27th and open for review until December 27th.**
- **This is the first of three public review periods.**
- **Expected final release in March/April time frame.**
- **OpenADR Alliance is formed and had its first meeting. 7 members, 12 more in the pipeline. Others under discussion.**

*OASIS - Organization for Advancement of of Structured Information Systems

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Over 50 vendors offer OpenADR clients

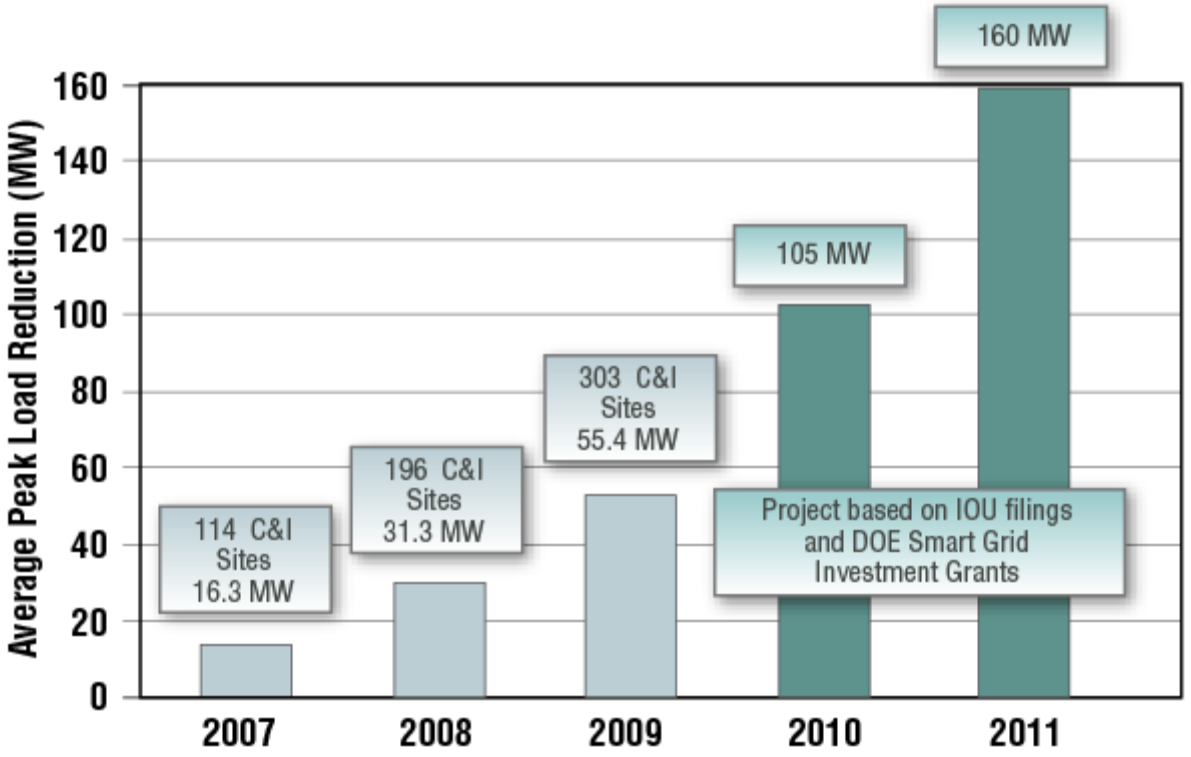
OpenADR – Applications in California

- **Large Commercial and Industrial Demand Response**

(Demand Bid, Capacity Bid, Peak Choice, Participating Load)

- **Price Response Notification and Automation**

(Retail: Critical Peak Pricing)



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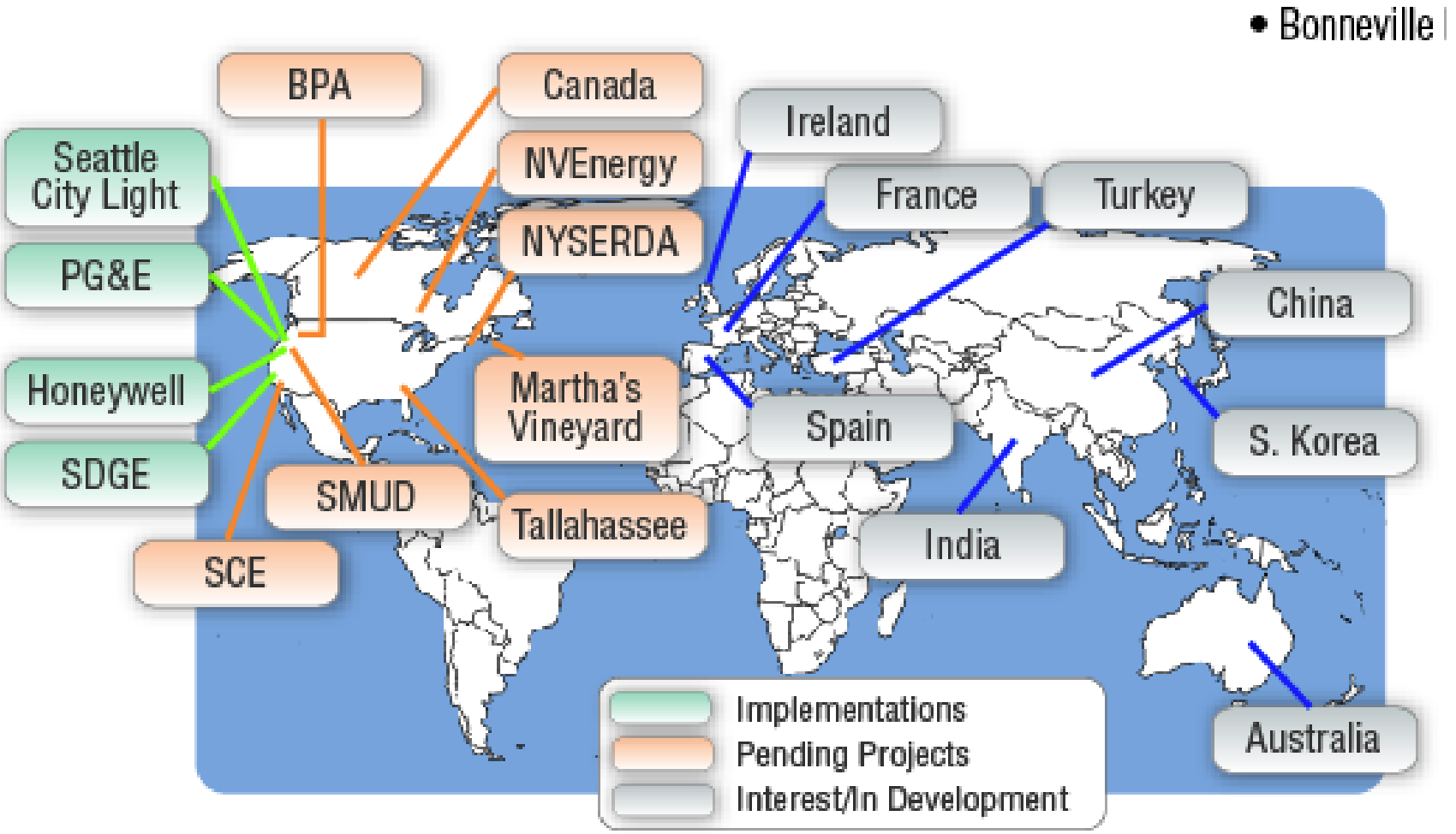
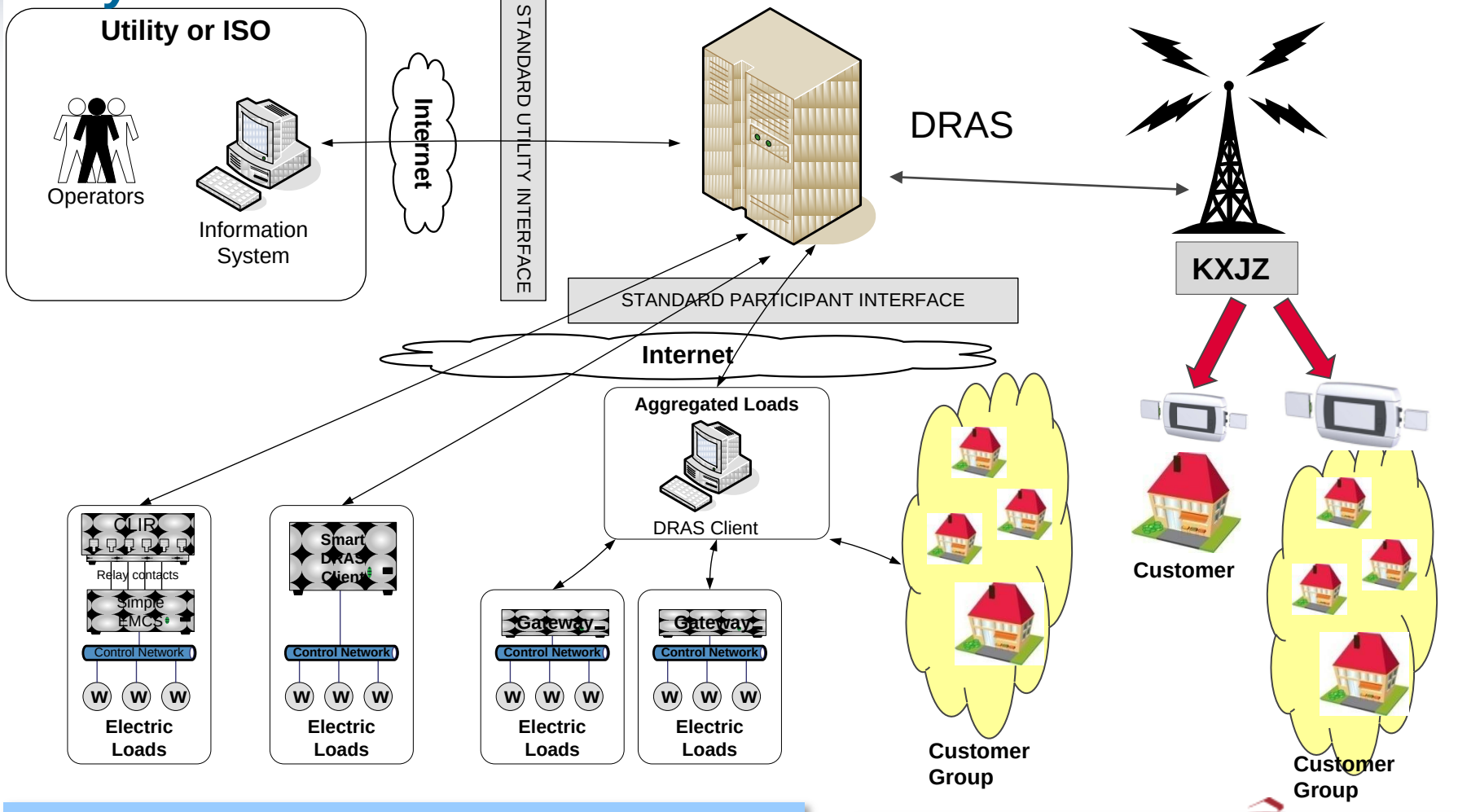
OpenADR Pilots and Projects – FIX SCE



Open Automated DR Communications System Architectures



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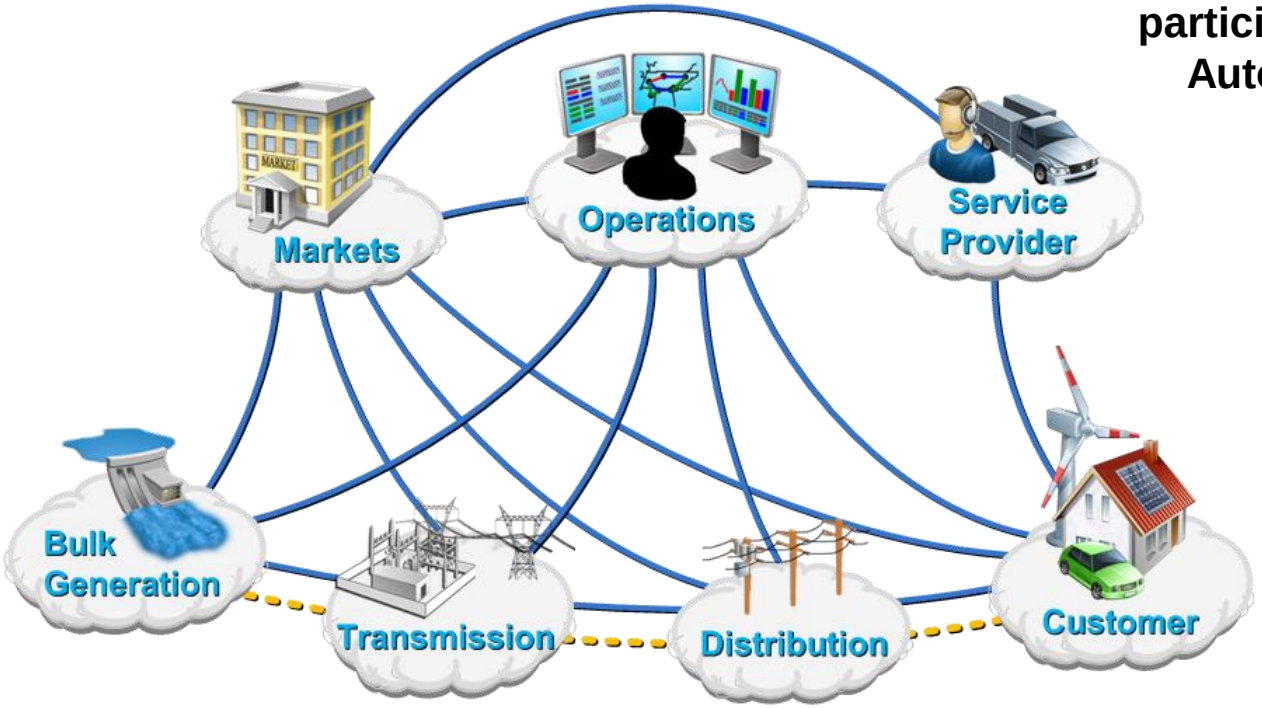
OpenADR NIST Standards Update

OpenADR deployed in numerous DR Programs

Multiple Service Providers participating in existing Auto-DR programs



Primarily C/I customers

(~50 Vendors)

Smart Grid Conceptual Model